Myiasis causing flies

By:
Zewdu Seyoum(DVM, MSc, MTAH)

http://www.uog.edu.et
Learning objectives

• At the end of this lesson students will be able to:
  ✓ explain what mean by myiasis
  ✓ identify those flies/larvae that cause myiasis
  ✓ explain their pathogenic and economic significances
  ✓ design treatment, control and prevention techniques of myiasis
Myiasis

- Is the **infestation** of living organs and tissues of host animals by the **larvae of dipteran flies**, usually known as **maggots or grubs**

- The fly **larvae feed** directly upon the **host’s living or dead/necrotic tissue** or, in the case of **intestinal myiasis**, on the **host’s ingested food** for at least a period

- **Host**: mammals, birds, amphibians or reptiles
Myiasis

• **Myiasis**: could be classified into different groups based on:
  
  ✓ **Anatomical localization/site of infestation**: in or on the animal
  
  ✓ **Host-parasite relationship**: biological interest

• Based on anatomical/site of infestation, it could be:
  
  ✓ **cutaneous/dermal** or **sub-dermal** *(example: *Lucilia*)
  
  ✓ **nasal**: e.g., *Oestrus* in nasal
  
  ✓ **somatic**: e.g., *Hypoderma*
Myiasis

- Based on host-parasite relationship, it could be:
  - **Facultative/optional**: e.g., Calliphorids
  - **Obligatory/strict parasite**: e.g., Oestridis
  - **Accidental**: e.g., Muscids- *Musca* group

- **Accidental or Pseudomyiasis**:
  - invade inappropriate host by chance
  - insects in the family Muscidae
  - **Larval stage** is the problem stage
  - enteric, accidental, rectal, and urinary
Types of Myiasis

• **Facultative:**
  - Can develop in both *living and dead organic matter*
  - maggots are free-living, but can become parasitic
  - attack carcasses, may attack living host

• **Obligatory:** *must have living* host to complete their development
  - maggots live on a live host for part of their life
  - are always parasitic; unable to survive without living host
Life cycle of myiasis producing flies

- **Complex metamorphosis** with egg, larval stages (instars), pupa, and adults;
- **Separate sexes:** with adult females laying eggs or larvae on host or in environment;
- Larvae hatch from eggs; three larval stages (maggots);
- Third larval stage pupates with adults emerging from pupae.
Myiasis Producing Flies

• Three families of flies are involved in myiasis occurrence:

1. Calliphoridae
2. Oestridae
3. Sarcophagidae
Family of Oestridae

• Contains flies commonly known as bots and warble

• Are obligate parasites

• most show a high degree of host specificity

• Adult flies: are large, usually hairy, have primitive non-functional mouthparts and short lived

• Larvae: highly host and site specific, and obligatory parasites

✓ spend considerable time: in feeding and developing in their host
Family of Oestridae

• develop in the *nasopharyngeal cavities* or skin *boils*(warbles) of mammals

• include four important genera:
  ✓ Hypoderma
  ✓ Oestrus
  ✓ Gastrophilus
  ✓ Dermatobia
**Hypoderma**: warble flies/cattle grubs

- Larvae live as **subcutaneous parasites**; are relatively **host-specific**
- **Host**: primarily cattle and sometimes equines, sheep, man
- **Species**: *Hypoderma bovis* and *H. lineatum*: affect cattle
- **Life cycle**: egg $\rightarrow$ maggot (L1 $\rightarrow$ L2 $\rightarrow$ L3) $\rightarrow$ pupa(on leaves) $\rightarrow$ adult: **complete metamorphosis**
- **Distribution**: WW
Morphology

1. Adults: *H. bovis* and *H. lineatum*
   - **Body**: is covered with **dense yellow-orange hairs** with a broad **band of black hairs** around the middle
   - **Mouthparts**: non-functional or vestigial
Adult *Hypoderma* fly or warble fly
Morphology

2. Larvae: mature/third stage larvae:

✓ are **thick** and somewhat **barrel shaped**, tapering anteriorly

✓ have **hooks** and **posterior spiracle plate** that completely surrounded by **small spines**

✓ **Segmented**: most segments bear **short spines**

✓ **Colour**: **dirty white** when newly emerged from host; then turns to **dark brown**
Larvae of warble fly in skin section
Newly emerged larvae
Life cycle

• **Adult females**: deposit their eggs on **hairs of the lower regions of the legs** and lower parts of the body;

• Eggs hatch and release **L1** → then the larvae crawl down the hairs and enter into skin or hair follicles → then migrate through connective tissue towards the region of the diaphragm by the aid of a **pair of mouth hooks** and **secretion of proteolytic enzymes**;
Life cycle

• The L1 feed as they travel to the resting sites: wall of oesophagus and epidural fat in the spinal canal → here L1 moult in to L2 → L2 then migrate to underneath of skin of the back → here L2 moult to L3, which cause swellings (‘warbles’) of skin → L3 then make cutaneous opening for breathing activities by inserting its spiracles into opening → after 4-6 weeks L3 emerge and fall to the ground → then the larvae pupate → adults emerge
Life cycle of *Hypoderma* species

1. **Adult fly lays eggs on hairs**
2. **Eggs hatch and larvae penetrate skin**
3. **Larvae migrate through tissue to back**
4. **Larvae under skin of back with breathing hole**
5. **Larvae fall to ground and pupate in soil. Adult fly**
Pathogenic significances

- **Economic loss**: down-grading values and condemnation of hides perforated by larvae, reduction of milk yield and weight gain.
- **Migratory behavior of larvae** via tissue causes **yellow or greenish, gelatinous, oedematous areas** due to **eosinophils infiltration**: known as ‘butchers jelly’.
- **Reduced carcass value**: due to tissue inflammation.
Pathogenic significances

- **Hypersensitivity reaction**: may cause **anaphylactic shock** particularly if the **larvae die in the animal tissue**

- Egg laying activity of the fly produces **self buzzing noise**: results in **avoidance behavior** of the host known as ‘gadding’ or panic or running away aimlessly to escape
Pathogenic significances

- **Gadding behavior**: resulting in *self-inflicted wounding*: since animals injure themselves on posts, barbed wire and other obstacles.

- **Flies noisy behavior**: also results in *animal feeding interruption*: results in *spontaneous abortion, retarded growth, reduced milk yield and reduced weight gains*. 
Clinical signs and diagnosis

- **Signs**: nodular lesion on back area; running away aimlessly

- **Diagnosis**: clinical signs: larvae in cysts or lumps under skin of the back indicate warble infestation; eggs may be found on hair of the animal’s legs
Nodules on the back due to Hypoderma larvae
Treatment, Control and Prevention

• **Mechanical removal of 3\textsuperscript{rd} stage larvae**: mature larvae may be squeezed out of the warble swelling

• **Insecticide treatment**: Use active organophosphorous and ivermectin systemically

• **Local fly eradication**: SIT, chemicals

• **Use vaccine**

• **Integrated management**: SIT, insecticide,
**Oestrus ovis**

- Commonly known as ‘nasal bots’;
- **Larvae:** are obligate parasites; spend their parasitic period in the air passage of hosts: nasal passages, frontal and nasal sinuses;
- Have high degree of host and site specificity;
- have posterior spiracular plate with numerous small pores
- **Adult flies:** have non-functional mouthparts, and are viviparous (lay larvae: L1)
**Oestrus ovis**

- **Host**: sheep, goat, rarely human beings
- **Site**: nasal passages and nasal sinuses
- **Species: Oestrus ovis**: have veterinary significance
- **Distribution**: WW
Morphology

1. Adults flies:

✓ Body: greyish-brown, with many small black spots on the thorax and abdomen

✓ Head: broad, with small eyes

✓ Mouthparts: reduced to small knobs: nonfunctional
Morphology

2. Mature larvae: L3

✓ Found in nasal passages

✓ Colour: yellow-white, tapering anteriorly

✓ Segmented: each segment has a dark transverse band dorsally

✓ Ventral surface of each segment bears a row of small spines
Adult *Oestrus ovis*
Oestrus ovis: larva in the sinus

Necropsy finding: sinus cavity of a sheep

larval Oestrus ovis
Oestrus ovis larvae
Larvae that penetrate into the gingival sulcus
Life cycle

- Undergo complete metamorphosis

- Female flies are viviparous, depositing/squirting a jet of liquid containing first-stage larvae at the nostrils at a time in or on the nostrils of the host, during the hottest part of the day when flies fly

- Then the larvae crawl up the nasal cavity to nasal sinuses and attach to the mucous membranes with its hooks; feeding on mucus: this secretion is stimulated by their movement
Live cycle

- Then the larvae enter the **frontal sinuses** where they develop into *2nd* and *dark brown third-stage larvae*

- Subsequently, the third-stage larvae crawl out of the **nostrils** or are **sneezed out by the host; pupate** in the ground; **adults** emerge 3–6 weeks later
Life cycle of *Oe. ovis*
Pathogenic significances

• **Adults flies**: egg laying activity can be lead to considerable disturbance and panic in a flock.

• **As adult flies deposit larvae**: the activity of adult flies may annoy or panic sheep: stamp their feet, bunch together and press their nostrils into each others’ fleeces and against the ground: leading to a loss of grazing time, reduced weight gain, loss of condition.

• Most infections are **light**: sheep showing nasal discharge, sneezing, and rubbing their noses on fixed objects.
Pathogenic significances

- **Heavy infections**: unthriftiness and sheep may circle and show in coordination: often termed as ‘false gid’

- **Dead larvae in the sinuses**: allergic and inflammatory responses: sneezing and 2°ry bacterial infection: cerebral involvement

- Larvae cause **irritation and excessive secretion**: oral hooks and spines effect

- Larvae cause **purulent rhinitis or sinusitis** leading to head shaking, restlessness, snorting or sneezing
Clinical signs

- mild discomfort, nasal discharge, sneezing, nose rubbing or head shaking, circling, in coordination, head pressing
- Decreased appetite, restlessness, weight loss, fly worry
- **Impaired respiration**: by larvae and the thickening of the nasal mucosa
- Larvae may penetrate nasal plate and subsequently enter the brain: causing injury, ataxia, circling/stagger and head pressing
Nasal discharge due to *Oe. ovis* infestation
Diagnosis

- **Clinical signs**: sneezing and nasal discharges; CNS disorders: restlessness, false gid, head shaking; season, keeping their muzzle near to the ground

- **Observation**: of dark brown larvae dropping out of nostrils after severe sneezing attack

- **Postmortem examination**: by sawing skull and separate it into half part longitudinally, then rinsing key areas with water: examine the water for larvae with lens
Management

• In heavy infection: use nitroxynil, tricleabendazole, rafoxanide and ivermectin are highly effective as are the organophosphates, trichlorfon and dichlorvos

• **Strategic treatment**: at the beginning of summer to kill newly deposited larvae and midwinter to kill overwintering larvae

• Fly repellant as prophylaxis
Gasterophilus: bot flies

- **Learning objectives:** at the end of this lesson students will be able:
  - ✓ illustrate their morphology
  - ✓ identify and distinguish them using their morphology
  - ✓ describe their life cycle and factors that influence breeding and survival of them
  - ✓ explain their pathological effect and economic significance
  - ✓ design their control and prevention mechanisms
General features

• Are commonly referred to as ‘bot flies’: horse stomach bot

• Are obligate parasites of horses, donkeys, mules, zebras, elephants and rhinoceroses

• Larvae, termed ‘bots’: spend most of their time developing in the stomach of equines, but they are generally considered of little pathogenic significance
General features

• **Host:** horses, donkeys, mules, zebras, elephants and rhinoceroses

• **Major species:** *G. intestinalis, G. nasalis, G. haemorrhoidalis*

• **Distribution:** WW
Morphology

• Adult bot flies:
  ✓ resemble to honey bee with a long curved ovipositor carried beanth the abdomen
  ✓ have **non functional** mouthparts
  ✓ are **robust dark/brown flies**; about 1-2cm long
  ✓ Body: is densely covered with **yellowish hairs**
  ✓ Wings: in most common species, there are **transverse bands or dark patches**; have no cross-venation
Gasterophilus species: adult fly
Adult flies of *Gastrophilus*
Morphology

• Mature / third stage larvae:

✓ present in the **stomach or passed in faeces**:

✓ are cylindrical, 1.6-2cm long and feed on tissue not on blood

✓ **reddish-orange** with posterior spiracles

✓ segmented: bears spines
Larvae of *Gastrophilus*
Life cycle

- Undergo complete metamorphosis
- Females deposit eggs on hairs of legs or face of horses.
- After hatching, larvae enter through the mouth and spend a period of development on the tongue and gums before moving to the stomach.
- After a period of 8–11 months in the stomach, bots pass out in the feces and pupate on the ground.
Eggs that glued on the hairs of horse
Horse bot eggs deposited on the skin of the legs and chest
Eggs attach to hair; larvae to gastric mucosa
Gastrophilus larvae that attach to the mucosa of horse
FIGURE 16.37 Common horse stomach bot, *Gasterophilus intestinalis* (Oestridae, Gasterophilinae); larvae attached to mucosa and inner surface of stomach of heavily infested horse. (Photo by Martin Hall, © The Natural History Museum.)
Pathogenic significances

- Induce great annoyance or panic to horses when adults approach horses to lay their eggs.
- **Bots**(larvae): may cause obstruction to the food passing from the stomach to intestine,
- Irritation by the larvae during migration: dermatitis, inflammation of the pharynx, oesophagus, stomach or rectum(rectal prolapse)
Pathogenic significances

• Larvae penetration with its hooks at the site of attachment: may result in stomatitis with ulceration of the tongue, erosions, ulcers, nodular mucosal proliferation, stomach perforation, gastric abscesses, peritonitis: inflammatory reactions

• Heavy infections: can cause general debilitation and even rectal prolapse

• Light infections are tolerable well
Clinical signs and diagnosis

• **Signs:** mild gastritis, stomatitis, pain on eating, annoyance

• **Diagnosis:** difficult, so it could be made by demonstration of larvae in the faeces; observation of the cream-white bot eggs on the animal’s hair
Management

• **Insecticide application**: carbon disulphide and trichlorfon; the broad spectrum insecticide/anthelmintics

• **Dichlorvos and ivermectin** are also very effective against bots

• **Fly repellant and frequent grooming**

• **Integrated management**: stimulate the eggs on the hair coat with warm water containing insecticides during summer and autumn; strategic treatment
Family Calliphoridae

- Are medium to large flies
- Almost all have a **metallic-blue** or **green sheen**
- Majority of the species are **saprophages**: living in decaying organic material
- Important genera that cause myiasis under this family include:
  - **Cochliomyia, Lucilia** and **Cordylobia**
Life cycle

• All are **oviparous** and except *Cordylobia* species, eggs are laid in wounded, infected or faecally soiled skin of warm blooded vertebrate hosts

• Larvae pass through **three instars** while feeding on the host tissues,

• causes **cutaneous or traumatic myiasis**

• Mature larvae drop on the ground and pupate in substrate → adult emerge
**Cochliomyia: Screw worm**

- Are **green to violet /bluish-green** blowflies with **three** prominent black, longitudinal stripes on the thorax, short palps and orange-brown eyes

- Are **obligate** ectoparasite

- Infest almost **all warm blooded** livestock, wildlife and humans

- Important species: *C. hominivorax* and *C. macellaria*
**Cochliomyia: Screw worm**

- **Host**: wild and domestic animals and humans;
- occur primarily in tropical areas;
- lay their eggs on wounds;
- Larvae characteristically feed as a colony and penetrate the tissues; creating a large and foul-smelling lesion.
Morphology

• Adult fly:
  ✓ Colour: deep greenish-blue metallic with a yellow, orange or reddish face and **three dark stripes** on the dorsal surface of thorax between the wings

• Larvae:
  ✓ tapered
  ✓ **segmented**: swollen ridges encircle each segment: hence the larvae look somewhat like **screws**
**Cochliomyia hominivorax**, the New World screw-worm fly.

**Cochliomyia hominivorax**, la lucilie bouchère du Nouveau Monde.

**Chrysomya putoria**, one of the Old World screw-worm fly.

**Chrysomya putoria** une des lucilles bouchères de l'Ancien Monde.
Larvae and adult fly of *Cochliomyia*
Larvae of Screw worm
Life cycle

• Undergo complete metamorphosis

• Female flies lay eggs on the skin of the host near open wounds: scratches, sores, barbed wire cuts, scabs, injuries from brand marks, dehorning/castration

• Eggs then hatched and release larvae/maggots

• Larvae start to feed invasively on secretions and living tissue

• Following completion of development, larvae fall to the ground and pupate in soil and adult emerge after 7-12 days
Pathogenic effects

• If untreated, repeated infestations may quickly lead to the death of the host

• Economic loss: use of insecticide, damage and disfigurement of skin

• Putrefied smelling discharges and ulcerations

• Treatment should be immediate

• Irrigate infested areas with ethanol + veggie oil

• May require surgery
Clinical signs

• Ragged, foul-smelling lesion containing larvae (maggots)
• Constant licking of the lesion by the animal
• Secondary infections and strikes are common
• Fever
• Lethargy and loss of appetite
• Debilitation
• Decreased growth rate
• Mortality rate in newborn calves from navel strike may be as high as 30-50%
Management

• Use insecticide: spraying or dipping livestock with coumaphous against the larvae

• Ivermectin

• Eradication: SIT
Blow flies: *Lucilia*

- Cause **cutaneous myiasis** and are **scavenger on dead animals**, decaying vegetable matter or garbage
- Important species: *L. sericata* and *L. cuprina*
- Are **facultative ectoparasites**: strike living wild and farm animals (sheep) that **have sores or wounds or are soiled with manure**
- Larvae infest and feed **on living tissues of warm-blooded vertebrates**: sheep
Blow flies: *Lucilia*

- Infestation by these species known as **blowfly strike**
- **Host:** mainly sheep (mainly **diarrheic sheep**), sometimes wild and domestic animals and humans
- **Distribution:** WW
Morphology

• **Adults**: - up to 1cm in length; have **black legs**
  - all have a **metallic blue or green sheen** on the body

• **Larvae**:
  ✓ Are **white to yellowish, smooth, segmented and blunt at the rear** and tapers towards the head
  ✓ possess a **pair of black oral hooks** for tearing flesh,
  ‌ spiracles on the anterior segment, and **stigmatic plates**
  ‌ also bearing spiracles
Colour of adult blow flies
**Lucillia**(R) and **Calliphora**(L)
*Lucilia* species causing myiasis of skin wound; larvae in skin wounds
Colour of adult blow fly; Larvae of it in skin wound
Larvae of blow flies
Life cycle

• Undergo **complete metamorphosis**

• Gravid female flies lay **eggs on wounds, soiled fleece or dead animals**, being attracted by the **odour of the decomposing matter**

• Then the eggs hatch and release larvae

• The larvae **feed on necrotic tissue, grow rapidly and moult twice to become fully mature maggots** in 3-10 days → then drop to the ground and pupate → adults emerge in 3-7 days
Epidemiology

• Occurrence of cutaneous myiasis in sheep depends on:

  ✓ temperature; flock size; stock density, rainfall

  ✓ host susceptibility: if the host has got putrefactive odours on the fleece due to bacterial decomposition of organic matter. It can be caused by soiling of the hindquarters due to urine or diarrhoea and injuries due to shearing, fighting or barbed wire

  ✓ Breed type: example Merino sheep

  ✓ sex: ram with narrow penile sheath
Pathogenic significances

- **Larvae lacerate skin with their oral hooks and proteolytic enzymes**, which digest and liquefy skin tissues.
- **Secondary blow fly strikes**: can occur and are strongly associated with faecal soiling, bacterial dermatophilosis and bacterial fleece rot (superficial dermatitis).
- **Secondary bacterial infection** can happen.
- **Extreme irritation and distress** can happen when larvae crawl over animals’ skin or into wounds: extremely debilitating and sheep can rapidly lose condition.
Clinical signs and diagnosis

- Increase body temperature and respiratory rate; weight loss and anorexia
- Anaemia and suffer toxaemia; inflammatory reaction
- Loss of fertility
- If untreated death
- Diagnosis: based on the clinical signs and recognition of maggots in the lesion
Management

✓ Good management: separate infected animals; avoid/clip hairs that surrounding the lesion; infested animals should be treated promptly

✓ Use suitable insecticides

✓ Control: prophylactic insecticide; sanitation or proper disposal of organic matters; worm management and wound management;

✓ Buried dead animals and other organic matter since blow flies can be attracted to dead animals

✓ Avoid injury during shearing, performing docking and castration
Sarcophagidae: flesh-flies

• Read morphology, lifecycle, pathogenic effects, management